Pressure generating unit

The invention relates to a pressure generating unit, in particular a pressure generating unit that is arranged in the handpiece of a vacuum biopsy apparatus that is embodied as a type of syringe and whereby, by retracting the piston in the evacuated cylinder space when changing over to generating overpressure, the air supply is released by the position of the piston.

Such a pressure generating unit in a vacuum biopsy apparatus is known from GMS 202 04363 or GMS 20211934. The pressure generating unit is connected via a connecting line to a biopsy needle unit that is inserted into the tissue to be examined. The pressure generating unit and the needle unit are arranged parallel in the housing of a handpiece. A vacuum is generated in the needle space for removing the specimen by means of the pressure generating unit.

In order to be able to use the pressure generating unit for generating an overpressure as well, an aeration aperture is provided, and when it is released by the syringe piston, the vacuum that was generated is removed so that the air that has since penetrated can be compressed by means of the syringe piston.

Because not only the specimen is drawn into the specimen removal space by the vacuum, but also tissue fluid is drawn in, when the aeration aperture is briefly released, tissue fluid that has penetrated into the cylinder piston space can flow out into the interior of the handpiece, in particular when the pressure generating unit and/or the handpiece with the needle unit and the pressure generating unit connected thereto is in an unfavorable position. In order to prevent this, it has already been suggested to seal the aeration aperture by means of a sponge that is arranged on the exterior of the piston cylinder. However, this is not sufficient in all cases.

The object of the invention is, therefore, first to allow the air required for removing the vacuum to flow into the cylinder and, second,

to reliably prevent outflowing tissue fluid from contaminating the housing interior space of the handpiece.

This object is obtained by connecting the evacuated cylinder space is connected via a connecting line to the cylinder space that is under atmospheric pressure and is on the other piston side, and by providing an absorbent element on the piston spindle.

By arranging a connection between the two cylinder spaces that are divided by the piston, whereby the connection is released or closed by the position of the piston, and by arranging an absorbent element in the cylinder space that is under atmospheric pressure, on the one hand air can flow into the evacuated part of the cylinder from outside; and on the other hand outflowing tissue fluid is drawn out of the evacuated cylinder part by the absorbent element. The length of the connection is selected so that the groove after the release of the connection for the inflow of air, the aperture of the cylinder space ending under atmospheric pressure, is over the absorbent element [sic]. This has the advantage that any tissue fluid that escapes during the brief opening of the connection is conducted directly into the element and absorbed by it.

The use of an air-permeable absorbent element furthermore has the advantage that the air coming in is filtered and thus particles cannot enter into the cylinder space.

It has proved particularly simple and cost-effective to use chemical pulp, in particular absorbent paper, as the material for the element.

It is advantageous that the element is held so that it cannot be displaced by means of a securing disk arranged on the piston spindle. This has the advantage that the element cannot migrate on the piston spindle during operation, which reduces the effectiveness of the element.

The invention is explained in greater detail below by means of an exemplary embodiment:

Fig. 1: The biopsy apparatus

Fig. 2: The pressure generating unit with piston pushed in (partial cut-away)

Fig. 3: The pressure generating unit after generating a vacuum by retracting the piston

Fig. 4: The pressure generating unit after releasing the connection for aeration

Fig. 5: Section A – A through Fig. 4

Fig. 6: Section B – B through Fig. 5

Fig. 1 illustrates a biopsy apparatus 1 in which the pressure generating unit 2 is housed in a housing with a needle unit 3 that is situated parallel thereto. The pressure generating unit is driven, for example, via an electro-gear motor (not shown) via the toothed wheel 4.

The pressure generating unit 2, which is constructed as a type of syringe, comprises a cylinder 5 in which a piston 6 is longitudinally displaceable by means of a piston spindle 7. The piston spindle drive comprises a toothed wheel 4 mounted on the open end of the cylinder, whereby the center of the toothed wheel is embodied as a spindle nut that interacts with the piston spindle 7 mounted therein. The piston spindle 7 is moved to the connector 8 or to the toothed wheel 4 by means of the toothed wheel 4, depending on the direction of rotation of the motor, via a pinion (not shown) that sits on the shaft of an electromotor. The cylinder of the pressure generating unit has at one end a connector 8 for a connecting piece 9 that is connected to the biopsy needle unit 3. Arranged on the side opposite the connector is a toothed wheel 4 with an interior spindle thread (spindle nut) that interacts with the piston spindle 7 so that with each rotation of the toothed wheel the piston 6 travels a precisely defined path to the one or the other side, depending on motor rotation. The toothed wheel can be mounted in the open cylinder end.

Depending on the direction of rotation, the piston 3 can be moved via the toothed wheel/spindle drive to the cylinder floor or away from the cylinder floor to the toothed wheel. The pressure generating unit is fitted for instance in a biopsy apparatus as it is illustrated in Fig. 1 and as it is described in greater detail in GMS 202 04 363; the distance between the housing wall 19 and insertion groove 20 for the piston spindle is selected so that the pressure generating unit cannot move in the longitudinal axis and the toothed wheel 4 is thus supported in the cylinder. When the piston is retracted to just in front of the aperture for the connecting line 21, here a groove 15 in the cylinder wall, i.e., in the direction of the toothed wheel 4, a vacuum forms in the biopsy needle system (see Fig. 3). After the air supply is released in the cylinder space 11 (opening of connecting line, groove is opened) – as described in the following – the underpressure previously created in the biopsy needle system (see Fig. 4) is removed by the inflow of air. If the piston is moved in the direction of the connector 8 after the air has flowed in, overpressure is created in the system.

The piston spindle carries the piston 10 with a rubber jacket on the side opposite the drive, i.e., on the connector side. On the interior piston cylinder wall, the rubber jacket of the piston seals the left-hand cylinder space 11 (space in front of the connector) from the cylinder space 12. In other words, if the connector support 8 is connected to the biopsy needle unit via the connecting piece 9 and the biopsy needle is inserted into tissue, for example, an underpressure occurs in the biopsy needle system due to the displacement of the piston to the drive side. The cylinder space 12 is furthermore under atmospheric pressure. Arranged on the side wall 13 of the piston, which is in the cylinder space 12, is an absorbent element 14 that is penetrated coaxially by the piston spindle and that is held, for example by means of a securing disk 18 that is attached to the piston spindle. The element is round and is situated so that it acts as a minor seal against the interior cylinder wall of the cylinder. In order to make it easy to pass over the piston spindle, the element embodied as a punched disk is slit. The element can comprise a plurality of individual disks that are approx. 1 mm thick. It can also be a single part, however. It extends approx. 3 mm. The element is placed directly on the piston side wall 13 and is held by the securing disk. A groove 15 is worked into the interior wall of the cylinder wall as a connection 21 on the cylinder part adjacent to the toothed wheel 4. As Fig.

5 illustrates, the depth of the groove is approximately half the wall thickness. The groove length (Fig. 5) is selected so that the groove ends when the air supply is released to the center of the absorbent element 14 and the cylinder space 11 to be aerated is connected to the exterior atmospheric pressure via the groove. In this position the groove has to a certain extent two "apertures." The one "aperture 17" ends in the cylinder space 11; the other "aperture 16" ends above the element 14 when the piston is brought to the open position (see Fig. 4).

When employing the vacuum biopsy equipment in accordance with GMS 202 04 363 or 202 11 934, it has been demonstrated that the suction action of the pressure generating unit 2 is so strong that, depending on the position of the biopsy apparatus when the specimen is drawn, more or less tissue fluid can enter into the pressure generating unit 2. By arranging a groove 15 in the interior of the cylinder, which [groove] is primarily needed because of the removal of the underpressure, it is not always possible to avoid the outflow of tissue fluid during the brief opening of the aeration aperture and its subsequent closing.

However, because the groove is designed so that the "aperture 16" ends over the absorbent element, the tissue fluid is absorbed and no tissue fluid flows into the housing of the biopsy handpiece. When the "aperture 16" of the groove is released (see Fig. 4) the air can travel from the cylinder space 9 to the absorbent element via the groove into the cylinder space 11 and remove the vacuum there. In other words, the air is filtered prior to its entering the cylinder space 11. Due to the electronic components installed [there], it is absolutely necessary to prevent the flow of tissue fluid into the housing of the handpiece of the biopsy apparatus because wet cleaning of the handpiece can lead to serious damage to the electronics.

In the exemplary embodiment, an interior groove is provided as a connection from the cylinder space 11 to the cylinder space 12. The connection can also be embodied as an exterior line or as a line that is integrated into the cylinder jacket. What is important for solving the problem is that the tissue fluid that can escape when the vacuum is removed can be intentionally conducted so that the tissue fluid is absorbed by means of an absorbent element and does not enter into the housing.

List of parts

1) Biopsy apparatus
2) Pressure generating unit
3) Needle unit
4) Toothed wheel
5) Cylinder
6) Piston
7) Piston spindle
8) Connector
9) Connection piece
10)
11) Cylinder space
12) Cylinder space
13) Side wall
14) Absorbent element
15) Groove
16) Aperture
17) Aperture
18) Securing disk
19) Housing wall
20) Insertion groove
21) Connection line
22)
23)
24)
25)
26)
27)
28)
39)